

Preparticipation predictors for championship injury and illness: cohort study at the Beijing 2015 International Association of Athletics Federations World Championships

Toomas Timpka,¹ Jenny Jacobsson,^{1,2} Victor Bargaría,^{1,3} Julien D Périard,⁴ Sébastien Racinais,⁴ Ola Ronsén,^{5,6} Karin Halje,^{1,7} Christer Andersson,¹ Örjan Dahlström,^{1,8} Armin Spreco,¹ Pascal Edouard,^{9,10,11} Juan-Manuel Alonso^{5,12}

► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136/bjsports-2016-096580>).

For numbered affiliations see end of article.

Correspondence to

Professor Toomas Timpka, Department of Medical and Health Sciences, Linköping University, Linköping SE-581 83, Sweden; toomas.timpka@liu.se

Accepted 17 October 2016

ABSTRACT

Objectives To determine preparticipation predictors of injury and illness at a major Athletics championship.

Methods A cohort study design was used. Before the 2015 International Association of Athletics Federations World Championships in Athletics, all 207 registered national teams were approached about partaking in a study of preparticipation health; 50 teams accepted. The athletes (n=957) in the participating teams were invited to complete a preparticipation health questionnaire (PHQ). New injuries and illnesses that occurred at the championships were prospectively recorded. Logistic regression analyses were performed with simple and multiple models using any in-championship injury and in-championship illness as outcomes.

Results The PHQ was completed by 307 (32.1%) of the invited athletes; 116 athletes (38.3%) reported an injury symptom during the month before the championships, while 40 athletes (13%) reported an illness symptom. 20 (6.5%) of the participating athletes sustained a health problem during the championships. Endurance athletes were almost 10-fold more likely to sustain an in-championship illness than speed/power athletes (OR, 9.88; 95% CI 1.20 to 81.31; p=0.033). Participants reporting a preparticipation gradual-onset injury symptom were three times more likely (OR, 3.09; 95% CI 1.08 to 8.79; p=0.035) and those reporting an illness symptom causing anxiety were fivefold more likely (OR, 5.56; 95% CI 1.34 to 23.15; p=0.018) to sustain an in-championship injury.

Summary and conclusions Analyses of preparticipation predictors of injury and illness at a major Athletics championship suggest that endurance athletes require particular clinical attention. Preparticipation symptoms causing anxiety are interesting predictors for in-championship health problems.

INTRODUCTION

During the month before world championships in large individual sports such as Athletics (track and field) and aquatic sports, about one-third of participating athletes report an injury problem; the Athletics athletes reporting a preparticipation injury symptom are at greater risk of an in-championship injury.^{1,2} Accordingly, extending methods for preparticipation athlete screening in individual sports from doping³ and cardiological risk factors⁴ to include a broad span of health problems seems

warranted. However, medical examinations and surveys of athletes before major competitions need to be optimally focused and presented in order to maximise participation and minimise disturbance. Previous studies have shown that illnesses sustained during championships are commonly caused by infection, allergies or are environmentally related,⁵⁻⁷ but no clear risk indicators have been identified. Regarding other types of distress among athletes, psychological and behavioural indicators stand out as early markers in sports where overuse is an important cause of health problems.^{8,9} Athletes become cognitively aware of perceptions indicating a health problem predominantly if these perceptions are unexpected or cannot be explained. Affective reactions, such as anxiety and worry, are evoked to support mental focusing on these new perceptions, while adaptation weakening the reactions occurs if the perceptions are repeated.¹⁰ For example, if a pain sensation is recognised and explained, the athlete will interpret the pain as non-threatening, correct expectations of its consequences and not be subjected to anxiety.^{11,12}

We hypothesised that experiencing health symptoms of certain types that influence participation or are associated with affective reactions before an international Athletics championship period would predict injury and illness at the championships. Our methodological approach was to investigate the strength of different measures of preparticipation health symptoms (symptoms with a notable duration, symptoms associated with reduced participation in athletics, a functional severity score, symptoms that cause anxiety, symptoms expected to influence competitions) as well as sex, age, home continent, event category and the availability of medical support during the final preparation as predictors of health problems at the championships.

METHODS

Study design and data collection procedures

A cohort study design was used to collect data before and during the 15th International Association of Athletics Federations (IAAF) World Athletics Championships in Beijing (22–30 August 2015). All 207 registered national teams were invited to participate in the study; 50 (24%) accepted. The 957 athletes in the participating teams (49% of all 1965 registered athletes) were

To cite: Timpka T, Jacobsson J, Bargaría V, et al. *Br J Sports Med* Published Online First: [please include Day Month Year] doi:10.1136/bjsports-2016-096580

Original article

invited to complete a preparticipation health questionnaire (PHQ) including individual preparticipation information (personal characteristics and health status during the month preceding the championship). During the period of the championships, newly incurred injuries and illnesses were recorded by national medical teams (physicians and/or physiotherapists) and/or by physicians on the local organising committee (LOC), using procedures established at previous championships.^{2–5} The study was introduced to all national medical teams and LOC physicians 1 month before the championships by email and on the day before the championships during a medical and antidoping meeting.

Self-reported preparticipation health symptoms were defined as symptoms of injury or illness that the athletes had experienced in the 4 weeks before the championships, even if the health problem had not considerably impacted the athlete's functional ability to partake in training and/or competition. In-championship injury and illness were defined according to the consensus on injury and illness reporting in athletics.¹³

The study protocol and PHQ were developed by a group of experts in sports medicine and epidemiology consisting of scientists and practitioners (see online supplementary figure S1). The overall goal was to extend the knowledge about risk indicators of sustaining an injury or illness during the championships. The PHQ was developed to collect information directly from the athletes regarding their personal situation (sex, age, country, event group, medical support) and health status (injuries or illnesses) during the 4 weeks preceding the championships (see online supplementary figure S2). The PHQ was available in a paper format (in English, French, Spanish, Russian, Japanese and Arabic). Athletes were asked to complete the questionnaire themselves and return it to designated desks at their hotel or the warm-up area.

Symptom severity was determined in two ways: (1) time lost from scheduled training was recorded and episodes with a duration of 3 days or more were regarded as notable and (2) functional severity scores were calculated using the PHQ items asking for information about adjustments in training schedules and impact on athletic performance, respectively. Response values from 0 to 3 were allocated to each of the two items so that a symptom severity score of 0 meant no limitation, and a score of 6 meant severe functional limitation. Worry/anxiety caused by the health issue and expectations of its impact on championship performance were queried using four-graded scales (none, minor, moderate, major; online supplementary figure S2, questions 13.3 and 17.3).

Confidentiality and ethical approval

The athletes' sex, date of birth and nationality were used to match data from the PHQ and the in-championship registration of injury and illness. Information about the purpose of the study and the procedure was provided to the athletes in writing and at information desks at the athlete hotels. All athletes were free to refuse the inclusion of their in-championship injury and illness data in the interpretation. All PHQs and injury reports were stored in a locked filing cabinet and made anonymous after the championships. The confidentiality of all information was ensured so that no individual athlete or national team could be identified. Ethical approval was obtained from the Research Ethics Board in Linköping (Dnr. 2015/132-31).

Data analysis

For the PHQ data, the response rate and completeness were assessed, and the athletes' characteristics and injury and illness

symptoms were analysed using descriptive statistics. Analysis of the non-responders was performed by comparing their distribution of home continent, the Human Development Index (HDI)¹⁴ for their home country, sex and age with the final study group.

For the in-championship injury and illness surveillance, the response rate, coverage and incidence calculations and comparisons were analysed in accordance with previous surveillance studies in Athletics^{2–5} using a list of athletes provided by the IAAF and the internet database.

For the final risk indicator analyses, the PHQ data were recoded into a 'long duration injury symptom' (yes/no), 'gradual-onset injury symptom' (yes/no), 'injury symptom causing anxiety' (yes/no), 'injury symptom expected to cause impact on championships performance' (yes/no), 'notable duration illness symptom' (yes/no), 'illness symptom causing anxiety' (yes/no), 'illness symptom expected to cause impact on championships performance' (yes/no), and injury and illness severity scores (0–6). Events were coded into the two categories speed/power events (sprints, hurdles, throws, jumps, combined events) and endurance events (middle and long distance running, marathon, race walking). We first performed analyses with simple models (logistic regression analyses with one explanatory variable) and thereafter analyses with multiple models (logistic regression analyses with several explanatory variables) with any in-championship injury (yes/no) and in-championship illness (yes/no) as outcomes (figure 1). The explanatory variables were sex, age, home continent, event category and preparticipation health symptoms with qualifiers (injury or illness symptom, onset type (injury symptoms only), reduction in participation, severity estimated by duration of time loss (more than 2 days was defined as a notable time loss), associated anxiety, expected performance impact, etc). The multiple models were fitted using backward elimination of non-significant variables (ie, variables with $p \geq 0.05$ were eliminated stepwise). The Statistical Package for the Social Sciences (SPSS) for Windows V.23.0 was used for the analyses. All statistical tests were two-sided and outcomes with $p < 0.05$ were regarded as statistically significant.

RESULTS

Study population

Three hundred and seven (32.1%) of the invited athletes accepted to participate in the study. Analysis of the non-responders did not show any meaningful differences between the final study group and the non-participant athletes with regard to sex; differences did exist for continents (higher non-participation among African and North American athletes ($p < 0.001$)) and older athletes (higher non-participation among athletes older than 25 years compared with those younger ($p = 0.001$)) (see online supplementary table S1a–c). The non-response was also slightly higher among athletes from developing countries, displayed by a negative correlation ($r = -0.29$; $p = 0.037$) between the HDI and the response rate at the national level. Two hundred and thirty (74.9%) of the participants reported that they had a medical practitioner available 4 weeks before the championships. The characteristics of the 307 participating athletes with regard to medical support, injury symptoms and illness symptoms 4 weeks before the championships are reported in table 1.

Preparticipation health symptoms

One hundred and sixteen of the 307 athletes (37.8%) reported an injury symptom during the month before the championships,

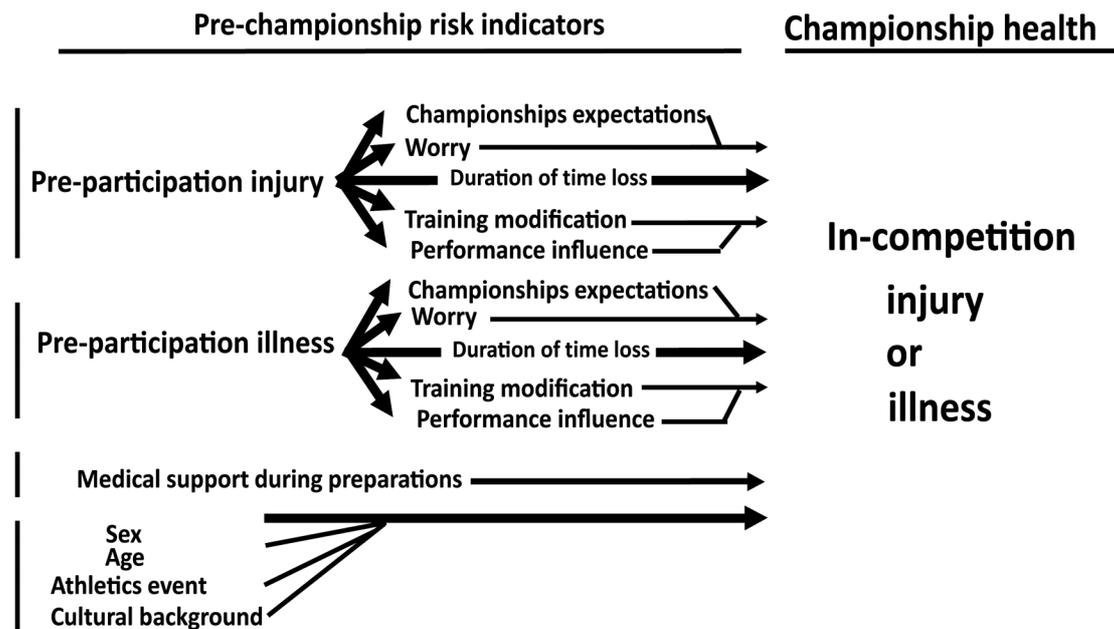


Figure 1 Display of analysis model.

Table 1 Characteristics of participating athletes with regard to medical support, injury symptoms and illness symptoms 4 weeks before the championships (n=307)

	Total (n=307)	Females (n=135)	Males (n=172)
Athlete medical support			
Medical practitioner available 4 weeks before championships, n (%)	230 (74.9)	104 (77.0)	126 (73.3)
Preparticipation medical examination performed, n (%)	175 (57.0)	72 (53.3)	103 (59.9)
National team at championships includes a medical practitioner, n (%)	253 (82.4)	116 (85.9)	137 (79.7)
Self-reported injury symptom in the 4 weeks before the championship, n (%)			
No	191 (62.2)	82 (60.7)	109 (63.4)
Yes	116 (37.8)	53 (39.3)	63 (36.6)
Self-reported illness symptom in the 4 weeks before the championship, n (%)			
No	267 (87.0)	115 (85.2)	152 (88.4)
Yes	40 (13.0)	20 (14.8)	20 (11.6)

while 40 athletes (13.0%) reported an illness symptom (table 1). There was no difference between male and female athletes with regard to frequency of reported symptoms. Twenty athletes (6.5%) reported both injury and illness symptoms, 96 athletes (31.3%) only an injury symptom, and 20 athletes (6.5%) only an illness symptom. One hundred and two athletes reporting injury symptoms (87.9%) reported that the injury symptom problem did affect their ability to participate in training and competition and 92 athletes (79.3%) stated that the injury symptom caused anxiety (table 2). The most frequently reported mode of onset was gradual (56.6%), followed by a sudden overuse (37.2%). Only 4 (3.5%) of the preparticipation injury symptoms were caused by trauma. About one-third of the injury symptoms (36.2%) had lasted more than 4 weeks. The 40 athletes reporting an illness symptom described 60 symptoms; 23 (38.3%) of these were indicative of allergy (shortness of breath, sneezing, congestion), 20 (33.3%) of infection (fever, sore throat,

diarrhoea, vomiting) and 11 (18.3%) of general fatigue (headache, abnormal fatigue). Twenty athletes (50.0%) reported that the illness symptom problem did affect their ability to participate in training and competition, while 14 athletes (35.0%) stated that the illness symptom caused them anxiety (table 2).

In-championship health problems

Twenty (6.5%) of the participating athletes sustained a health problem during the championships; 12 (3.9%) athletes sustained only an in-championship injury, 4 athletes (1.3%) reported only an in-championship illness and 4 athletes (1.3%) sustained both an in-championship injury and reported an in-championship illness. The most frequent location of injury was the ankle (33.3%), followed by the lower leg (22.2%). The most commonly reported cause of injury was overuse (61.5%). The most common illness cause (62.5%) was exercise-related (hyperthermia/dehydration).

Associations between preparticipation risk factors and in-championship injuries

The simple model analyses showed that several categories of health symptoms reported in the month before the championship were associated with an increased likelihood of in-championship injury; gradual-onset injury symptoms (OR, 3.19; 95% CI 1.14 to 8.94; $p=0.027$), the injury symptom severity score (OR, 2.78; 95% CI 1.01 to 7.66; $p=0.048$), notable duration illness symptoms (OR, 4.08; 95% CI 1.21 to 13.70; $p=0.023$) and the illness symptoms causing anxiety (OR, 5.87; 95% CI 1.46 to 23.64; $p=0.013$) were all associated with an increased likelihood of injury (table 3). Tendencies for association with in-championship injury were observed for injury symptoms with notable duration ($p=0.060$), and for injury symptoms causing anxiety ($p=0.081$). In the analyses of the multiple models, only the gradual-onset injury symptoms (OR, 3.09; 95% CI 1.08 to 8.79; $p=0.035$) and the illness symptoms causing anxiety (OR, 5.56; 95% CI 1.34 to 23.15; $p=0.018$) remained associated with in-championship injury.

Table 2 Preparticipation health problems (self-reported injury and illness symptoms) displayed by sex and symptom type

	Injury symptom			Illness symptom		
	Females (n=53)	Males (n=63)	Total (n=116)	Females (n=20)	Males (n=20)	Total (n=40)
Level of Athletics participation, n (%)						
Adjustment of training or competition	41 (77.4)	53 (84.1)	94 (81.0)	8 (40.0)	8 (40.0)	16 (40.0)
Performance decrease	44 (83.0)	46 (73.0)	90 (77.6)	7 (35.0)	9 (45.0)	16 (40.0)
Training or competition adjustment or performance decrease	47 (88.7)	55 (87.3)	102 (87.9)	9 (45.0)	11 (55.0)	20 (50.0)
Mode of onset, n (%)						
Sudden onset (traumatic cause)	1 (1.9)	3 (5.0)	4 (3.5)	–	–	–
Sudden onset (overuse cause)	18 (34.0)	24 (40.0)	42 (37.2)	–	–	–
Gradual onset	33 (62.3)	31 (51.7)	64 (56.6)	–	–	–
Other incident, not related to training or competing in athletics	1 (1.9)	2 (3.3)	3 (2.7)	–	–	–
Symptom characteristics						
Severity score, mean (SD)	2.6 (1.9)	2.5 (1.8)	2.5 (1.8)	1.2 (1.4)	1.0 (1.2)	1.1 (1.3)
Duration, n (%)						
0 days	0 (0.0)	1 (1.6)	1 (0.9)	1 (5.0)	1 (5.0)	2 (5.0)
1–2 days	6 (11.3)	5 (7.9)	11 (9.5)	5 (25.0)	7 (35.0)	12 (30.0)
3–7 days	15 (28.3)	15 (23.8)	30 (25.9)	9 (45.0)	9 (45.0)	18 (45.0)
2–4 weeks	13 (24.5)	19 (30.2)	32 (27.6)	5 (25.0)	0 (0.0)	5 (12.5)
>4 weeks	19 (35.8)	23 (36.5)	42 (36.2)	0 (0.0)	3 (15.0)	3 (7.5)
Caused anxiety, n (%)	43 (81.1)	49 (77.8)	92 (79.3)	8 (40.0)	6 (30.0)	14 (35.0)
Expected to impact on championship performance, n (%)	24 (45.3)	30 (47.6)	54 (46.6)	4 (20.0)	1 (5.0)	5 (12.5)

Associations between preparticipation risk factors and in-championship illness

The simple model analyses showed that older age (OR, 1.17 (1.02 to 1.33) ($p=0.022$)) and participation in an endurance event were associated with an increased illness risk during the championship (OR, 9.88; 95% CI 1.20 to 81.31; $p=0.033$) (table 4). Analyses of the multiple models also revealed that participating in an endurance event per se was associated with an in-championship illness (OR, 9.88; 95% CI 1.20 to 81.31; $p=0.033$).

DISCUSSION

We found that participating in an endurance event was associated with a 10-fold increase in the likelihood of sustaining an illness during the Athletics championship. Regarding in-championship injuries, preparticipation injury symptoms with a gradual onset were associated with a three times increased likelihood, while the likelihood for sustaining an injury was five times greater for athletes reporting a preparticipation illness symptom causing anxiety. These findings have implications for athlete preparticipation screening, organisation of medical services, as well as for preparations of athlete support.

Illness, exertion and diagnostic routines

Although sustaining an in-championship illness was relatively rare among the participants (2.6% of the athletes), endurance athletes were 10-fold more likely to sustain an illness compared with participants in speed/power events. An increased illness risk among endurance athletes at Athletics championships has also been previously observed.¹⁵ Of the athletes participating in this study, 5 (1.6%) were reported to have developed an exertional health illness during the competitions, with symptoms such as nausea, vomiting, dizziness, and an irregular heart rate, palpitations and syncope. However, no core temperature values were recorded to confirm the diagnosis, which limits the

possibility of drawing further conclusions about heat exertion as the cause of illness during Athletics championships. The observations instead call for routine use of structured methods for diagnosis of exertional health illness among Athletics athletes in warm climates. Recent research has shown that the magnitude of cardiovascular adaptations related to repeated exposure to heat stress is variable and dependent on several factors such as exercise intensity, duration of exposure, frequency and total number of exposures, as well as the environmental conditions (ie, dry or humid heat) in which exposure occurs.¹⁶ Regular use of core temperature values along with documentation of symptoms would allow reliable diagnosis of exertional health illness and, eventually, preventive measures to be individualised. Besides environmental conditions, athlete-specific factors such as non-functional over-reaching¹⁷ should also be considered as possible explanations for the increased illness risk among endurance athletes. In this context as well, development of clear diagnostic criteria for use at Athletics championships is warranted.

Predictors of in-championship injury

While preparticipation gradual-onset injury symptoms have been recognised as predictors for in-championship injury,² anxiety-related symptoms have not been highlighted in this context. It is worth noticing that although 'illness' symptoms causing anxiety were associated with a fivefold increase in the likelihood of in-championship 'injury', anxiety-causing 'injury' symptoms only displayed a tendency for association. Instead, injury symptoms characterised by a gradual onset were associated with a greater likelihood for in-championship injury. This discrepancy may be explained by the affective response associated with the perception of particular health problems being weakened following repeated exposures.¹⁰ If athletes can explain a recurring health problem for themselves, the perception linked to the problem will progressively generate weaker affective reactions and receive less attention. Such adaption may

Table 3 Risk indicators for sustaining an in-championship injury presented as ORs (95% CI) calculated by simple and multiple logistic regression analyses (n=307)

	95% OR	
	In-championship injury	
	Simple models	Multiple model
Sex	NS	
Age	NS	
Continent (reference Europe)	NS	
Africa	NS	
Asia	NS	
Australia	NS	
North America	NS	
South America	NS	
Event category (reference speed/power)	NS	
Endurance (Middle and long distance running, marathon, race walking)	NS	
Prechampionships medical support available	NS	
Preparticipation health symptoms	NS	
Injury symptoms	NS	
Reduced participation	NS	
Gradual-onset	3.19 (1.14 to 8.94) (p=0.027)	3.09 (1.08 to 8.79) (p=0.035)
Severity score	2.78 (1.01 to 7.66) (p=0.048)	
Notable duration (>2 days)	NS*	
Anxiety caused	NS**	
Expected impact at championships	NS	
Illness symptoms	NS	
Reduced participation	NS	
Severity score	NS	
Notable duration (>2 days)	4.08 (1.21 to 13.70) (p=0.023)	
Anxiety caused	5.87 (1.46 to 23.64) (p=0.013)	5.56 (1.34 to 23.15) (p=0.018)

*p=0.060; **p=0.081.
NS, not significant.

explain why anxiety-related illness symptoms in this study were found to be more accurate predictors of in-championship injuries than the anxiety-related injury symptoms. Among Athletics athletes, injury symptoms often have a gradual onset, which predisposes the athletes to 'explaining-away' the severity of the health problem, thereby suppressing the emotional response.¹⁸ In comparison, the onset of illness among athletes is usually sudden leaving little time for 'explaining away' the symptoms, implying that the illness-related anxiety is likely to be rational and proportional to the 'true' severity of the problem.¹⁹ It should also be noted that symptoms of both preparticipation 'injury' and 'illness' increased the likelihood of sustaining in-championship 'injuries'. This observation suggests that there are several different aetiological pathways by which preparticipation health problems predispose athletes to suffer in-championship injuries.

Study strengths and limitations

This study has both strengths and potential limitations. A major strength is that it is, to the best of our knowledge, the first study

Table 4 Risk indicators for sustaining an in-championship illness presented as ORs (95% CI) calculated by simple and multiple logistic regression analyses (n=307)

	95% OR	
	In-championship illness	
	Simple models	Multiple model
Sex	NS	
Age	1.17 (1.02 to 1.33) (p=0.022)	
Continent (reference Europe)	NS	
Africa	NS	
Asia	NS	
Australia	NS	
North America	NS	
South America	NS	
Event category (reference speed/power)	9.88 (1.20 to 81.31) (p=0.033)	9.88 (1.20 to 81.31) (p=0.033)
Endurance (middle and long distance running, marathon, race walking)	NS	
Prechampionships medical support available	NS	
Preparticipation health symptoms	NS	
Injury symptoms	NS	
Reduced participation	NS	
Gradual-onset	NS	
Severity score	NS	
Notable duration (>2 days)	NS	
Anxiety caused	NS	
Expected impact at championships	NS	
Illness symptoms	NS	
Reduced participation	NS	
Severity score	NA	
Notable duration (>2 days)	NS	
Anxiety caused	NS	

NA, not applicable; NS, not significant.

of preparticipation predictors of health problems during major championships in individual sports that includes both illnesses and psychological factors. However, the PHQ response rate among the athletes (32.1%) is relatively low, and it should be noted that the routine for preparticipation data collection was designed to minimise our disturbance of the athletes. On that note, the study was performed in the beginning of a period with intense doping debate in Athletics, which may have caused the athletes to be more reluctant to answer questions that they thought could lead to further enquiries, possibly linked to use of prohibited substances. Taking all these matters into consideration, the PHQ response rate can be regarded as acceptable. Moreover, reaching out to more than 200 national teams with many different languages is methodologically challenging. To avoid language, social or other cultural biases in the analyses and the interpretation of results, a detailed study of non-response patterns at team and individual levels is warranted. A comprehensive set of non-response analyses was therefore performed in the present study. No indication was found to suggest that the results should be profoundly skewed. Nevertheless, lower response rates were observed from African and North American countries and from countries ranked low on the HDI.

Original article

For future studies, modern information technology could allow for the provision of data to be even simpler for the athletes,²⁰ and the forms to be electronically distributed as soon as the championships preparations have been finished (ie, before arrival at the venue). However, when introducing such technology at international championships, it must be ensured that the electronically communicated materials can be equally allocated by participants from all countries and do not add to skewness in response patterns.

Implications for clinical service planning

Concordant with previous studies,^{1 2} almost every second participating athlete (44.3%) reported having experienced a health problem (injury or illness) during the month before the championships. Providing the possibility for elite athletes to discuss their health concerns with clinical professionals before major competitions therefore appears to be essential. However, in this study, no association was found between the availability of a clinical practitioner during the 4-week period before the championships and in-championship health issues for the athletes. This observation may be explained by the notion that facilitation of optimal training and at the same time maintaining the elite athlete's long-term health is a challenging task with contradictory elements. It is arguable that the organisation of the clinical services provided before major championships could affect the decision-making regarding training adjustments and medical interventions.

Both formal models for return to sport²¹ and pragmatic clinical models²² have been outlined for assisting in such decision processes. The pragmatic clinical model tries to reconcile between 'evidence-based' and 'preference-based' medicine²³ by involving the athletes and coaches in clinical decision-making. The associations observed in this study between preparticipation health symptoms causing anxiety and health problems sustained at the championships call for inclusion of clinical psychological competencies in this decision process. The clinical teams should be able to reactively support elite athletes in management of psychological issues associated with injury rehabilitation, as well as proactively support management of reactions accompanying new symptoms of injury and illness.²⁴ Studies have shown that clinical psychological interventions that endorse adequate responses to anxiety are effective among general populations of young adults.^{25 26} To further reinforce elite athletes' involvement in clinical decision-making before major championships, educational interventions to promote the athletes' understanding of their own physical and psychological health, and how these aspects interact, are also called for.²⁷

Summary

Analyses of preparticipation predictors of injury and illness at a major Athletics championship suggest that endurance athletes require particular clinical attention. Preparticipation symptoms causing anxiety are interesting predictors for in-championship health problems. Consequently, providing possibilities for elite athletes to discuss their health concerns with clinical professionals before major competitions may be of great importance to reduce the risk of sustaining illness or injury. Diagnostic criteria for different types of exertion-related illness and the clinical and educational services provided to athletes preparing for championships in individual sports warrant further study.

What are the findings?

- ▶ Participants in endurance events were 10-fold more likely to suffer an in-championship illness than participants in speed/power events.
- ▶ Athletes reporting a preparticipation illness symptom causing anxiety were fivefold more likely to sustain an in-championship injury.

How might it impact on clinical practice in the future?

- ▶ Endurance athletes may require specific medical attention in order to avoid illness at athletics championships.
- ▶ Preparticipation illness symptoms associated with athlete anxiety indicate the potential for a health problem (ie, injury) to develop during a major Athletics championship.

Author affiliations

¹Athletics Research Center, Linköping University, Linköping, Sweden

²Swedish Athletics Association, Stockholm, Sweden

³Department of Orthopaedics and Rehabilitation, Moi University, Eldoret, Kenya

⁴Athlete Health and Performance Research Centre, Aspetar Orthopaedic and Sports Medicine Hospital, Doha, Qatar

⁵Medical and Anti-doping Commission, International Association of Athletics Federations (IAAF), Monaco

⁶Aker Solutions, Lysaker, Norway

⁷Young Adults Centre, Region Östergötland, Linköping, Sweden

⁸Department of Behavioural Sciences and Learning, Linköping University, Linköping, Sweden

⁹Department of Clinical and Exercise Physiology, Sports Medicine Unity, Faculty of Medicine, University Hospital of Saint-Etienne, Saint-Etienne, France

¹⁰Inter-university Laboratory of Human Movement Biology (LIBM EA 7424),

University of Lyon, University Jean Monnet, Saint Etienne, France

¹¹Medical Commission, French Athletics Federation (FFA), Paris, France

¹²Sports Medicine Department, Aspetar Orthopaedic and Sports Medicine Hospital, Doha, Qatar

Twitter Follow Jenny Jacobsson at @Jenny_Jacobsson and Juan Manuel Alonso at @DrJuanMALonso

Acknowledgements The authors value the cooperation of the team physicians and physiotherapists, the Local Organising Committee, and the Local Organisation Medical Managers of the 2015 IAAF World Championships who volunteered their time to collect the data for this project. The authors are also grateful for the assistance from the IAAF Medical and Anti-doping Commission and Department in the implementation of this research.

Contributors TT, J-MA and OR made substantial contributions to the conception of the study. TT, J-MA, JJ, JDP, SR, OR and PE made substantial contributions to the study design. TT, J-MA, JJ, KH, VB and CA were involved in data collection. TT, OD and AS were involved in the analysis of the data. All authors made substantial contributions to data interpretation. TT made a substantial contribution to the drafting and writing of the article. All authors were involved in revising the manuscript and final approval of the version to be published.

Competing interests None declared.

Ethics approval Research Ethics Board in Linköping.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Mountjoy M, Junge A, Benjamin S, *et al.* Competing with injuries: injuries prior to and during the 15th FINA World Championships 2013 (aquatics). *Br J Sports Med* 2015;49:37–43.
- 2 Alonso JM, Jacobsson J, Timpka T, *et al.* Preparticipation injury symptom is a risk factor for injury: a prospective study of the Moscow 2013 IAAF Championships. *Br J Sports Med* 2015;49:1118–24.

- 3 Robinson N, Dollé G, Garnier PY, *et al.* 2011 IAAF World Championships in Daegu: blood tests for all athletes in the framework of the Athlete Biological Passport. *Bioanalysis* 2012;4:1633–43.
- 4 Corrado D, Schmied C, Basso C, *et al.* Risk of sports: do we need a pre-participation screening for competitive and leisure athletes? *Eur Heart J* 2011;32:934–44.
- 5 Alonso JM, Edouard P, Fischetto G, *et al.* Determination of future prevention strategies in elite track and field: analysis of Daegu 2011 IAAF Championships injuries and illnesses surveillance. *Br J Sports Med* 2012;46:505–14.
- 6 Theron N, Schweltnus M, Derman W, *et al.* Illness and injuries in elite football players—a prospective cohort study during the FIFA Confederations Cup 2009. *Clin J Sport Med* 2013;23:379–83.
- 7 Edouard P, Depiessé F, Branco P, *et al.* Analyses of Helsinki 2012 European Athletics Championships injury and illness surveillance to discuss elite athletes risk factors. *Clin J Sport Med* 2014;24:409–15.
- 8 Carfagno DG, Hendrix JC III. Overtraining syndrome in the athlete: current clinical practice. *Curr Sports Med Rep* 2014;13:45–51.
- 9 Timpka T, Jacobsson J, Dahlström Ö, *et al.* The psychological factor 'self-blame' predicts overuse injury among top-level Swedish track and field athletes: a 12-month cohort study. *Br J Sports Med* 2015;49:1472–7.
- 10 Wilson TD, Gilbert DT. Explaining away. A model of affective adaptation. *Perspect Psychol Sci* 2008;3:370–86.
- 11 Crombez G, Eccleston C, Vlaeyen JWS, *et al.* Exposure to physical movements in low back pain patients: restricted effects of generalization. *Health Psychol* 2002;21:573–8.
- 12 Trost Z, France CR, Thomas JS. Exposure to movement in chronic back pain: evidence of successful generalization across a reaching task. *Pain* 2008;137:26–33.
- 13 Timpka T, Alonso JM, Jacobsson J, *et al.* Injury and illness definitions and data collection procedures for use in epidemiological studies in Athletics (track and field): consensus statement. *Br J Sports Med* 2014;48:483–90.
- 14 Human Development Index (HDI). *Human Development Reports 2015*. United Nations Development Programme. <http://hdr.undp.org/en/content/human-development-index-hdi> (accessed 1 Apr 2016).
- 15 Alonso JM, Tscholl PM, Engebretsen L, *et al.* Occurrence of injuries and illnesses during the 2009 IAAF World Athletics Championships. *Br J Sports Med* 2010;44:1100–5.
- 16 Périard JD, Travers GJ, Racinais S, *et al.* Cardiovascular adaptations supporting human exercise-heat acclimation. *Auton Neurosci* 2016;196:52–62.
- 17 Schweltnus M, Soligard T, Alonso JM, *et al.* How much is too much? (Part 2) International Olympic Committee consensus statement on load in sport and risk of illness. *Br J Sports Med* 2016;50:1043–52.
- 18 Jelvelgård S, Timpka T, Bargoria V, *et al.* Perception of health problems among competitive runners: qualitative study of cognitive appraisals and behavioural responses. *Orthopaed J Sports Med* 2016. In press.
- 19 Leeuw M, Goossens ME, Linton SJ, *et al.* The fear-avoidance model of musculoskeletal pain: current state of scientific evidence. *J Behav Med* 2007;30:77–94.
- 20 Karlsson D, Timpka T, Jacobsson J, *et al.* Electronic data capture on athletes' pre-participation health and in-competition injury and illness at major sports championships: an extended usability study in athletics. *Health Informatics J* 2016. Published online First.
- 21 Creighton DW, Shrier I, Shultz R, *et al.* Return-to-play in sport: a decision-based model. *Clin J Sport Med* 2010;20:379–85.
- 22 Dijkstra HP, Pollock N, Chakraverty R, *et al.* Managing the health of the elite athlete: a new integrated performance health management and coaching model. *Br J Sports Med* 2014;48:523–31.
- 23 Quill TE, Holloway RG. Evidence, preferences, recommendations-finding the right balance in patient care. *N Engl J Med* 2012;366:1653–5.
- 24 American College of Sports Medicine; American Academy of Family Physicians; American Academy of Orthopaedic Surgeons; American Medical Society for Sports Medicine; American Orthopaedic Society for Sports Medicine; American Osteopathic Academy of Sports Medicine. Psychological issues related to injury in athletes and the team physician: a consensus statement. *Med Sci Sports Exerc* 2006;38:2030–4.
- 25 Rickwood DJ, Telford N, Mazze K, *et al.* Changes in psychological distress and psychosocial functioning for young people accessing headspace centres for mental health problems. *Med J Aust* 2015;202:537–42.
- 26 Halje K, Timpka T, Tylested P, *et al.* Self-referral psychological treatment centre for young adults: a 2-year observational evaluation of routine practice before and after treatment. *BMJ Open* 2015;5:e008030.
- 27 Prien A, Mountjoy M, Miller J, *et al.* Injury and illness in aquatic sport: how high is the risk? A comparison of results from three FINA World Championships. *Br J Sports Med* Published Online First: 16 June 2016. doi:10.1136/bjsports-2016-096075



Preparticipation predictors for championship injury and illness: cohort study at the Beijing 2015 International Association of Athletics Federations World Championships

Toomas Timpka, Jenny Jacobsson, Victor Bargarria, Julien D Périard, Sébastien Racinais, Ola Ronsen, Karin Halje, Christer Andersson, Örjan Dahlström, Armin Spreco, Pascal Edouard and Juan-Manuel Alonso

Br J Sports Med published online November 8, 2016

Updated information and services can be found at:
<http://bjsm.bmj.com/content/early/2016/11/08/bjsports-2016-096580>

References

These include:

This article cites 23 articles, 11 of which you can access for free at:
<http://bjsm.bmj.com/content/early/2016/11/08/bjsports-2016-096580#BIBL>

Email alerting service

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To request permissions go to:
<http://group.bmj.com/group/rights-licensing/permissions>

To order reprints go to:
<http://journals.bmj.com/cgi/reprintform>

To subscribe to BMJ go to:
<http://group.bmj.com/subscribe/>